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Quarterly Update

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Summary of SEI Accomplishments: 2Q90

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This section provides a summary of accomplishments from April–June 1990

FM-628-85-C-0003

Three evaluation teams from Space and Naval Warfare Systems Command (SPAWAR) and Naval Ocean Systems Center (NOSC) participated in a **Software Capability Evaluation** training program in June at the SEI.

The first **Process Definition Steering Committee** meeting was held in June at the SEI. The steering committee is composed of leading software process researchers and practitioners from government, industry, and academia. More than thirty people attended the two-day meeting.

The **Software Process Modeling Project** hosted the bimonthly meeting of the Post Deployment Software Support (PDSS) Subgroup of the DoD Joint Logistics Commanders Joint Policy Coordinating Group on Computer Resources Management. The military handbook *Mission-Critical Computer Resources Software Support*, developed by the PDSS Subgroup, was approved by the DoD this quarter.

Real-Time Scheduling in Ada Project members assisted McDonnell Douglas personnel in preparing a presentation to NASA recommending that rate monotonic scheduling be the standard discipline for designing real-time software for the Space Station Data Management System.

The Software for Heterogeneous Machines Project completed a prototype implementation of a Durra task to be used as a building block for communication network modeling.

A course for executives, **Software: Profit Through Process Improvement**, was held at the SEI in June. The 10-hour course was attended by upper management representatives from 10 organizations.

The six instructors from the Air Force Institute of Technology and the two civilian participants in the **Course Development Workshop** returned to their respective sites. During the six-month workshop at the SEI, these participants developed five graduate-level continuing education courses, which will be presented by the instructors who participated in the workshop.

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The SEI hosted the **information object modeling (IOM) technical interchange/workshop** in mid-June, which was attended by representatives of all STARS prime contractors and which addressed issues regarding the future applicability of IOM to the STARS Program.

The **SQL Ada Module Extensions (SAME) Design Committee** held its June meeting in conjunction with the SQL Rapporteur Group of the International Standards Organization Working Group on Ada. The working group will vote on the SAME Description Language as a draft proposed standard at its December meeting.

Members of Technology Applications and the SEI Process Program began to collaborate with the **Computer Resource Management Technology (CRMT) program** to transition several SEI concepts and products. The CRMT program is the engineering program that the Air Force uses to transition advances in computer resources management, including software technologies, into Air Force practice.

Eight new **industry affiliates**, five new **academic affiliates**, and two new **resident affiliates** joined the SEI this quarter.

Computer Emergency Response Team (CERT) members conducted the **Second Invitational Workshop on Computer Security Incident Response** in June. This workshop focused on new ideas and models in the area of incident handling as well as lessons learned. There were more than 100 attendees and 40 speakers from the federal government, academic community, and private industry.

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Software Engineering Process

The Software Engineering Process Program focuses on improving the process of software development. Projects within the program are assessing the actual practice of software engineering in the defense community, training organizations to gain management control over their software development processes, supporting the use of quantitative methods and measures as a basis for process improvement, and developing improved methods for software process management.

Software Capability Evaluation

The Software Capability Evaluation (SCE) Project helps DoD acquisition organizations to evaluate the capability of contractors to competently develop and maintain software. The project is improving and transitioning an evaluation method for use in software-intensive acquisitions.

In June, project members updated and baselined descriptions of the software process areas (such as configuration management and project planning) contained in the capability maturity model. The tables itemizing significant practices in these software process areas were also updated and baselined. The descriptions and tables were reviewed at the March 1990 workshop and within the Process Program prior to baselining. This proposed baseline was released to the maturity questionnaire and model working group, composed of 70 industry, government, and academic representatives who are actively participating in the project's revision effort through reviews and workshops. Project members plan to draft a maturity questionnaire revision based on the content and coverage of the practices contained in this baseline.

Three evaluation teams from Space and Naval Warfare Systems Command (SPAWAR) and Naval Ocean Systems Center (NOSC) participated in a Software Capability Evaluation training program on June 19-21 at the SEI. Project members presented an overview of SCE (course 1) and lead the teams through simulated visits to two contractor sites (course 2).

The project leader participated on a panel at the Structured Development Forum held in San Diego in May. The panelists presented their views on how software quality can be improved and answered questions from the audience and the moderator. The session was attended by 75 participants primarily from industry.

In June, project members visited the Swedish Defense Acquisition agency (FMV) in Stockholm, Sweden, to collect feedback on their use of the capability evaluation method in two multi-year-funded contracts. The FMV funded the trip. While in Sweden, project members visited three software companies to learn more about their process technology. Two companies have successful projects with highly mature software management and engineering processes.

Project members presented an overview of the project and discussed the capability maturity model during an April meeting in Pittsburgh with the AIA (Aerospace Industries Association) Software Quality Assurance Subcommittee.

Software Process Assessment

The Software Process Assessment Project assists software organizations in launching effective process improvement programs, characterizes and reports on the software engineering capabilities of defense contractors, and defines priority needs for software process improvement in the defense community.

Project members acted as observers for self-assessments conducted by Jet Propulsion Laboratories in San Diego, California, and Ashton Tate in San Jose, California. The project frequently provides one or two observers experienced in assessments to attend an organization's initial self-assessment.

Project members conducted the sixth self-assessment training session at the SEI in May. Forty-three registrants from five affiliate organizations attended. The training prepares software professionals to assess the software engineering capabilities of their organizations. The training was preceded by a one-day pre-assessment training tutorial in software process management and the capability maturity model.

A self-assessment briefing was held in Pittsburgh in June. Seventy-eight participants attended. Special self-assessment briefings were given to Tinker Air Force Base in Oklahoma City, Oklahoma, and to the Army Material Command at the SEI during this quarter.

The fourth (and final) SEI-assisted assessment planned for fiscal year 1990 was completed during this quarter. The on-site phase was conducted in April for TRW (Systems Integration Division / West Coast) in Redondo Beach, California. (During the on-site phase, the assessment team conducts extensive discussions with project managers and software practitioners, and briefs the senior executives on the team's view of the organization's most pressing software process issues.) A final assessment report and a briefing on action recommendations were delivered to TRW in June.

Project members conducted assessment tutorials at the United Technologies Engineering Coordination and Activities Conference and Trade Show in Stamford, Connecticut, and in Montreal for Canadian representatives from academia, the aerospace industry, and government agencies who have been given the funding to do a study to create an SEI Canada.

Software Process Development

The Software Process Development Project is advocating the use of measurement in the practice of software development and management. Toward that end, it coordinates a steering committee, two working groups, and a best-practices study, all devoted to encouraging organizations to use quantitative methods to improve their software process.

The Software Metrics Definition Working Group and the Software Acquisition Metrics Working Group met separately for three days each in May and June, respectively. Both working groups are developing documents that specify measures of products, processes, and project characteristics that can be widely and consistently used. Both groups have scheduled additional meetings throughout the year. The Software Metrics Definition Working Group plans to complete a preliminary draft of its document for review by January 1991. The Software Acquisition Metrics Working Group plans to have a draft available for review later in 1991.

The correspondence group has grown significantly and now has about 100 members. It will be the source for future openings in the working groups and the Measurement Steering Committee.

To encourage organizations to adopt measurement, project members are collecting best practices and motivations, which will be published in an SEI technical report. To further the collection, project members visited Hewlett Packard in Palo Alto, California; IBM Communications Products in Raleigh, North Carolina; and IBM Federal Sector Division in Houston, Texas. Additional visits are planned.

Project members made presentations to the National Security Industrial Association, the DoD Inspector General, the Technology Cooperation Program, and a Defense Systems Management College (DSMC) train-the-trainer's course on Total Quality Management. They also presented to an International Standards Organization working group and plenary meetings, the annual meeting of the International Society of Parametric Analysts, and a Computer Science Corporation technology exchange forum.

Project members also spoke with a NASA Goddard Space Flight Center software program office, and gave a presentation to visiting members of the faculty of the University of Lund in Sweden.

Software Engineering Process Definition

The Software Engineering Process Definition (SEPD) Project supports process improvement through the maturation of the methods and technology associated with software engineering process definition. The project is developing the capabilities required to support the definition and evolution of software processes within an organization. This project began as a task within the Software Process Development Project.

The project completed the context analysis phase during this quarter. The project team held five on-site meetings with Standard Systems Center (SSC) personnel at Gunter Air Force Base. They gathered and analyzed data for the development of a detailed strategy and plan to assist SSC with the implementation of process improvement based on process definition capability.

During these meetings, the relationship between the SEPD Project and the newly formed SSC Software Management Council (SMC) and its working groups was established. The project and the working groups will collaborate to develop process definitions for the focus area assigned to each working group, and will conduct pilot improvement efforts.

The project team met with the working group chairs to identify selection criteria for pilot projects to be conducted during the implementation phase of the SEPD Project. Project members conducted interviews of candidate projects, and identified those projects that will be used for the initial pilot efforts.

The project team reviewed draft action plans from two SMC working groups in preparation for elaborating and implementing these plans during the next phase of the project.

The first Process Definition Steering Committee (PDSC) meeting was held on June 12-13 at the SEI. The steering committee is composed of leading software process researchers and practitioners from government, industry, and academia. More than thirty people attended the two-day meeting, which included a detailed overview and discussion of the project, presentations by participants, and a roundtable discussion of issues.

Project members began cataloging a process definition library. It will include recently published material on process, process modeling, process definitions, and related areas. More than 50 documents were added to the library during this quarter.

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The project team held a three-day meeting with an independent consultant to establish a work plan for the development of a state of the practice report on the use of software process in Europe. This report will provide coverage of process definition methods and technologies that are employed in Europe and that would be applicable to the SSC process improvement effort.

Project members met with Texas Instruments in Dallas, Texas, and IBM Federal Sector Division in Houston, Texas, to review their approach to implementing process definitions.

Project members made presentations at the Air Force Software Technology Support Center Conference, and to the Joint Logistics Commanders Post-Deployment Software Support subgroup, the Air Force Science Advisory Board, and representatives from Scott Air Force Base.

Software Engineering Methods

The primary objective of the Methods Program is to improve the practice of software engineering by improving individual and team productivity through the identification and transition to practice of emerging software technology. Promoting the appropriate use of this technology supports the SEI effort to transform software development from an ad-hoc, labor-intensive activity to a technology-supported engineering discipline.

Software Development Environments

The Software Development Environments Project is studying the problem of tool configuration management (CM) and is tracking the state of environment architectures with a focus on configuration management functionality.

To address the problem of managing tool configuration, project members began investigating appropriate approaches to integrating tools, especially those with complex data management schemes and multi-user support. Based on lessons learned from the initial data model for the tool configuration prototype, this task involves in-house experimentation with tools and CM systems embedded in new generation environment frameworks. This task will lead to the development of requirements for interfaces between tools and CM.

The Navy is working on standardizing the next generation of programming support environments. The project leader is deputy to the working group coordinating the Navy's effort with the STARS (Software Technology for Adaptable, Reliable Systems) Program. This will involve formulating strategies and reference models for the coordinated Next Generation Computer Resources/Programming Support Environments (NGCR/PSE) and STARS effort.

The project demonstrated the benefits and limitations of CM usage models as implemented in the Sun Network Software Environment (NSE), at the request of various government agencies. This work will collectively be presented on videotape as part of the Technology Series of the SEI Video Dissemination Project.

Software Architecture Design Principles

To develop a fundamental understanding of structures for the software architecture level of design, this project is describing basic design elements used in the description, analysis, and development of software systems.

The report *User Interface Software Structures* (CMU/SEI-90-SR-13) was completed this quarter. This report codifies the structural choices faced by designers of user interface software. It describes how these choices can be based on system requirements. The report was submitted as a joint paper for the SEI and the Department of Computer Science.

The project leader gave a panel presentation on "Competitiveness and Software" at the AI Systems in Government Conference per request of the Office of Naval Research (ONR), and made presentations on software architectures to IBM Federal Sector Division, Bell Northern Research Labs, and at the SEI Educator Development Workshop.

The project leader continued public services activities, which included serving on and attending meetings of several advisory boards including: Computer Science and Technology Board, DARPA/ISTO Information Science and Technology (ISAT) Summer ▶

Study, and ACM Panel on Distinguished Advisory Board. She also is serving on a planning panel for the ACM Distinguished Advisory Board and is a distinguished reviewer of the ACM/IEEE Curriculum '90.

Software Process Modeling

The Software Process Modeling Project is investigating techniques for modeling software development and maintenance processes.

In May, the project hosted the bimonthly meeting of the Post Deployment Software Support (PDSS) Subgroup of the DoD Joint Logistics Commanders Joint Policy Coordinating Group on Computer Resources Management. A project member represents the SEI on the PDSS Subgroup. The subgroup was established to address and resolve problems and issues related to the support phase of the software life-cycle and create products that can be used DoD-wide to improve and standardize the software support process. The PDSS Subgroup is composed of representatives from the Army, Navy, Marine Corps, Air Force Logistics Command (AFLC), and Air Force Systems Command (AFSC).

The project team developed a model of the PDSS process prescribed in MIL-HDBK-347, *Mission-Critical Computer Resources Software Support.* This military handbook was developed by the PDSS Subgroup and was approved by the DoD this quarter. The model developed by the project was presented and discussed at the PDSS Subgroup meeting in May. In-depth discussions regarding this model were also conducted with Software Technology Support Center (STSC) personnel, resulting in the clarification of a number of issues and resolution of various questions. Corresponding changes to the model have been made in preparation for delivery to Ogden Air Logistics Center.

Project members presented a half-day tutorial entitled "Post Deployment Software Support Process Modeling" at the USAF STSC-HQ USAF/SC Joint Software Conference in Salt Lake City in April. The tutorial explained the process modeling work being done at the SEI; discussed the F-14A, F-16 A/B, and MIL-HDBK-347 models that the project members built; and outlined the benefits which arose from developing the models.

A project member is serving as tutorial chair for the 1990 Conference on Software Maintenance, to be held in San Diego in November. During this quarter, he participated in the Program Committee meeting held in Washington, D.C., and selected the set of tutorials to be presented at the conference

In April, the project leader presented a full-day seminar entitled "Software Process Modeling" for the Association for Computing Machinery, Washington D.C. Chapter, Spring Professional Development Seminar Series, in College Park, Maryland.

Domain Analysis

This project is developing and testing methods for performing domain analysis to support software reuse. The primary objectives of the project are to define a process and set of products to support the systematic discovery and exploitation of commonality across related software systems and to apply the process to a domain within the Army Tactical Command and Control System (ATCCS).

The project defined the methods to be used for its domain analysis and applied them in analyzing window management software. In addition, project members implemented a tool to handle consistency checking of the domain model and are using STATEMATE to simulate the model and applications specified using the model. ▶

Project members completed a comprehensive, annotated bibliography on domain analysis (CMU/SEI-90-SR-3). The document presented references on the comparatively new discipline called domain analysis. Its purpose is to provide an historical perspective on the field as well as necessary background information for further work in the discipline. During this quarter, the project began defining the scope of the domain analysis to be performed with ATCCS. The ATCCS program consists of five major systems to support tactical battlefield operations. The systems are built on common hardware and support software, and, as part of the scoping effort, the project met with working groups specifying the common support software. Project members are proposing man-machine interface software as the initial domain for analysis. Our effort in this area will be to apply the results of the feasibility study to help refine the ATCCS System Segment Specification in the area of window management software. Project members also will look at that aspect of the man-machine interface that deals with battlefield map representations.

Another of the project's scoping activities is defining the context for analysis of movement control software. This software manages and controls the movement of tactical battlefield resources. It supports three planning activities: preparing movement requests, coordinating those requests with the appropriate Army command headquarters, and maintaining movement files.

Project members presented at a technical interchange meeting at the CECOM Center for Software Engineering and at the Third Annual Workshop on Methods and Tools for Reuse.

Survey of Formal Specification Techniques for Reactive Systems
(CMU/SEI-90-TR-5)

A Domain Analysis Bibliography
(CMU/SEI-90-SR-3)

User Interface Software Structures
(CMU/SEI-90-SR-13)

For information on how to order reports, see page 27.

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Software Engineering Methods Program Reports

April–June 1990

Software Systems

The goal of the Systems Program is to improve the development of real-time distributed systems by integrating software engineering with systems engineering and reducing the risk of new technology.

Real-Time Embedded Systems Testbed

The Real-Time Embedded Systems Testbed Project is collecting, classifying, generating, and disseminating information about software development for real-time embedded systems.

The project has received over 60 requests for the Version 1.0 of Hartstone benchmark and accompanying information. (The Hartstone benchmark is designed to measure the performance of a compilation system on real-time applications with hard scheduling deadlines. Version 1.0 contains the Periodic Harmonic Series.) Of these requests, approximately half have come from industry, and the remainder is almost equally split between government, academia, and Ada compiler vendors.

Hartstone results were gathered for six Ada compilers: DDCI, DEC VAX/VMS, Rational, System Designers, TeleSoft, and Verdix. A report analyzing the results is near completion.

New versions of the Ada Compiler Evaluation Capability (ACEC) and Ada Evaluation System (AES) test suites were installed. These test suites will be used, along with Hartstone, to perform extensive evaluations of the Verdix compiler. This evaluation technology, along with new evaluation technology for distributed systems, will be used to support the BSY-2 effort of the Government Electronics Systems division of General Electric in Moorestown, New Jersey.

Real-Time Scheduling in Ada

The Real-Time Scheduling in Ada Project is demonstrating how to design and implement real-time systems using analytic scheduling algorithms.

Project members assisted McDonnell Douglas personnel in preparing a presentation to NASA recommending that rate monotonic scheduling be the standard discipline for designing real-time software for the Space Station Data Management System. If the recommendation is approved, everyone developing real-time software for the Data Management System will use rate monotonic methods unless they have a waiver.

The introduction of rate monotonic scheduling concepts to General Electric (GE), the prime contractor for the Navy's BSY-2 system, is proceeding well. Several training sessions were held with GE personnel, and the project's training materials are being used by GE trainers to train other workers on the project. The project assisted GE personnel in analyzing selected software designs from the system to show how the rate monotonic theory could be used successfully during the design phase to identify potential problems and to develop alternative designs. The prospects are reasonably good that the technology will be adopted by the BSY-2 program because it has already proven to be helpful in identifying potential problems early in the design phase. ▶

A technical report, *Implementing Sporadic Servers in Ada* (CMU/SEI-90-TR-6), was completed this quarter. This report presents the data structures and algorithms for implementing sporadic servers in real-time systems programmed in Ada. (The sporadic server algorithm is an extension of the rate monotonic scheduling algorithm.)

An introductory article on rate monotonic scheduling appeared in the April 1990 issue of *Computer* magazine, and a report demonstrating how the rate monotonic theory can be applied to solve a common class of problems is nearing completion. Work is also proceeding on identifying technical issues in applying rate monotonic theory to distributed systems.

Validation tests for checking the Ada implementations of the priority ceiling protocol have been designed, and a report describing their use is in the final stages of preparation. Several Ada compiler vendors have been contacted and have expressed interest in obtaining the tests.

User Interface

The User Interface Project is developing Serpent, a user interface management system. Serpent separates the concerns of the user interface from those of the application, which allows integration of input/output technologies without modifying the functional portion of the application.

The .8 release of Serpent, which contains a snapshot of the new layout editor, was made available to the public through electronic distribution. Serpent now runs on VAX (ULTRIX 3.1), DECstation (ULTRIX 3.1), Sun (OS4.0), and HP 9000 OS Version 6.0.

Project members exhibited Serpent at the Conference for Computer-Human Interaction (CHI '90) and at USENIX. They also participated in a UIMS panel at Xhibition 90 and chaired a study group on UIMSs under the auspices of the IEEE P1201 standards group. Presentations examining UIMS systems from a standards perspective were also made to other groups, including the Open Software Foundation and a NIST working group on environments.

Design work for the remaining two pieces of Serpent 1.0 was completed this quarter. The two pieces are: (1) the integration of the layout editor with the structure editor and (2) a generalized method for incorporating Xtk-based toolkits into Serpent. The user interfaces for the structure editor and the visualization editor were integrated and are being tested and refined. A color palette has been developed for the visualization editor and was added to the Serpent demo suite.

The latest Serpent newsletter was distributed. One of the items in the newsletter announced the availability of a Serpent videotape that presents a manager's perspective of Serpent. Over 60 requests for the videotape have been filled.

Software for Heterogeneous Machines

The Software for Heterogeneous Machines Project is developing tools and a methodology for building distributed, large-grained, concurrent applications running on heterogeneous machine networks. The project has developed Durra, a language for describing distributed applications as a set of task descriptions and type declarations that prescribe a way to manage the resources of the network. ▶

In conjunction with the Institute for Simulation and Training (IST) at the University of Central Florida, the project is designing a demonstration system to simulate a network of simulators and training devices using SIMNET protocols for the wide-area network and SIMNET or proprietary protocols for the local-area networks.

The project is developing a Durra task to be used as a building block for communication network modeling. After the design is implemented and tested, it will be integrated into the runtime executive as a built-in task. Design goals include developing an application description style in which the application tasks are split into "tightly-coupled" communication groups and deciding how much information is shared between communication tasks. The project completed a prototype implementation of the task this quarter.

Project members upgraded the Ada development tools to the beta release of VADS 6.0. This beta release contains a number of changes (for example, pragma syntax and library unit names) that are incompatible with VADS 5.5. In collaboration with the SEI Technology Transition staff, a new release of Durra was built and installed on the public access host for anonymous file transfer protocol (FTP).

As part of a team of reviewers appointed by DARPA Tactical Technology Office (TTO), Mario Barbacci attended the preliminary design review for the designs by Honeywell and Texas Instrument for the Aladdin multiprocessor sponsored by DARPA.

Implementing Sporadic Servers in Ada
(CMU/SEI-90-TR-6)

For information on how to order reports, see page 27.

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Software Systems Program Reports

April–June 1990

Education

The primary objective of the SEI Education Program is to increase the number of highly qualified software engineers by rapidly improving software engineering education throughout the education communities of academia, government, and industry. To accomplish this, the projects of the Education Program focus on accelerating the development of software engineering programs in academia and on enhancing opportunities for the continuing education of practitioners.

This summer Carnegie Mellon is offering one course in its new Master of Software Engineering (MSE) program, a joint effort between the SEI and the CMU School of Computer Science. The course, Software Development Studio, is a continuation from the spring semester. It consists of a team effort by the students to complete all phases of a realistic software development project. Four students are enrolled in this course.

The SEI has five new academic affiliates: Mississippi State University, University of Virginia, Florida Atlantic University, Troy State University, and University of California, Los Angeles. The academic affiliates are educational institutions who have contractually joined the SEI in cooperative efforts of mutual interest. These efforts include work in education, training, research, development, or technology transition.

Software Engineering Curriculum

The Fourth SEI Conference on Software Engineering Education was held April 2-3 in Pittsburgh. Attended by approximately 100 educators, the program included presentations by invited speakers, refereed papers from an international group of software engineering educators, panel discussions, and reports from the SEI. The conference proceedings were published by Springer-Verlag as part of their Lecture Notes in Computer Science series.

The Eighth SEI Educator Development Workshop was held April 4 in Pittsburgh. The 71 attendees included representatives from academia, government, and industry. Two new curriculum modules and one set of support materials were presented, all on the topic of concurrent programming (see p. 15 for titles). Presentations by SEI staff included software architectures and using temporal logic to develop specifications.

Dr. Norman Wilde of the University of West Florida was in residence as a visiting scientist for a four-week period. He developed a curriculum module tentatively titled *Understanding Program Dependencies.*

The project leader and the program director participated in the International Federation for Information Processing working group (IFIP WG) 3.2 workshop on "Informatics Curricula for the 90s" in Providence, Rhode Island, on April 5-7. About 50 participants (half from the U.S., half from Europe, Canada, and Mexico) discussed issues related to the design and content of curricula for the immediate future. Several speakers expressed their high regard of theoretical computer science and formal approaches to programming; a few suggested that computing also has an engineering component. SEI ▶

participants report that they gained insight into the widely varying perceptions of what computer science (informatics) is; that insight will help shape the curriculum efforts of the Education Program.

The project leader was invited to participate in a working group entitled "The Impact of Computing Education on the Software Crisis." Meeting in conjunction with the National Educational Computing Conference, the group addressed very high-level and broad issues. Participants were, among others, the presidents of the ACM and IEEE-CS, Senator Albert Gore (who has sponsored legislation in support of advancing the United States computing capabilities), a vice president of Apple Computers, and representatives of NSF and ICCP (Institute for Certification of Computer Professionals, which is currently developing an examination for certification of software engineers).

Video Dissemination

The Video Dissemination Project provides courses on modern software engineering methods. The project has three series of videotaped courses: the Academic Series, which develops graduate courses that are offered by universities for academic credit; the Continuing Education Series, which offers noncredit courses to software practitioners in government and industry; and the Technology Series, which provides stand-alone presentations that promote awareness of emerging issues and leading-edge technologies.

The Academic Series completed its sixth semester of production by videotaping two courses: Software Creation and Maintenance, and Software Verification and Validation (version 2). These courses are available for use by participating universities for the fall 1990 semester.

During the spring 1990 semester a total of 228 students received credit for completing course work in Academic Series courses offered at 9 universities in the United States and Canada. A total of 17 class sessions were held: 12 of Software Project Management; 3 of Software Design; and 2 of Software Verification and Validation.

Course authors made site visits to two participating schools: The Wichita State University (Software Project Management) and the University of Minnesota, Duluth (Software Verification and Validation). While at Wichita State, the course author presented one of the lectures.

For the summer semester, Software Design is being offered at Florida Institute of Technology, and Software Verification and Validation is being offered at six sites of Florida Atlantic University. Tutors from these schools participated in an SEI-sponsored tutor orientation.

Tutors from Rockwell International, Westinghouse Electric, McDonnell Douglas, and the Air Force who were trained in previous offerings of the course at the SEI have taught Software Project Management at their respective organizations. So far they have trained more than 110 students and 23 tutors. Invited SEI staff presented lectures held at tutor training sessions at McDonnell Douglas in Mesa, Arizona, and Westinghouse Electric Company in Pittsburgh. ▶

A course for executives, Software: Profit Through Process Improvement, was held at the SEI on June 5-6, 1990. The 10-hour course was attended by upper management representatives from Xerox, Ford Aerospace, Martin Marietta, Rockwell International, Texas Instruments, Pacific Bell, Motorola, United Technologies Research Center, Boeing Aerospace, and the United States Navy.

Participants in the Course Development Workshop returned to their respective sites: six instructors from the Air Force Institute of Technology (AFIT) and one representative each from General Dynamics and the University of Scranton. During the six-month workshop at the SEI, these participants developed five courses: Software Generation and Maintenance, Principles and Application of Software Design, Software Specification, Software Verification and Validation, and Software Engineering Concepts. Final development of the courses will be done by the participants at their home locations. The five graduate-level continuing education courses will be presented at AFIT by the instructors who participated in the workshop.

Advanced Learning Technologies

The Advanced Learning Technologies (ALT) Project is using hardware and software technologies to teach software code inspections. Interactive, technology-intensive training can be distributed economically to a broad audience and can provide an effective learning experience.

A context-sensitive help system was developed for the interactive video course on inspections. Support for multiple fonts and colors in text windows was also added to the course. The second CD-ROM check disk was created; this version will be used by the beta sites that are testing the course.

The project leader gave a seminar on the project at the University of Michigan. In attendance were approximately 50 faculty and graduate students from the Department of Computer Science, Cognitive Science and Machine Intelligence Laboratory, and the School of Education. They are considering using ALT as a model for their development of a new DVI project at the university.

Education Program Reports

April–June 1990

Software Engineering Education Directory
(CMU/SEI-90-TR-4)

Technical Writing for Software Engineers
(SEI-CM-23)

Concepts of Concurrent Programming
(SEI-CM-24)

Language and System Support for Concurrent Programming
(SEI-CM-25)

Support Materials for "Language and System Support for Concurrent Programming"
(SEI-SM-25)

For information on how to order modules and reports, see page 27.

Ada & STARS Support

As Ada use becomes more common in software-dependent systems, users will be faced with the benefits and problems of adopting more disciplined approaches to software engineering. The goals of the Ada and STARS (Software Technology for Adaptable, Reliable Systems) Support Effort are to remove technical and managerial impediments to the adoption of Ada, to support the DoD STARS Program in technology development and transition efforts, and to explore the advantages and disadvantages of new software engineering approaches and paradigms made possible by Ada language features.

Program members participated in the following STARS activities during this quarter: STARS program management review, system architects meetings, S-increment proposal reviews, and the review of the Boeing/Hughes information object modeling (IOM) effort. They were also interviewed by and discussed the STARS Program with the DoD Inspector General.

The SEI hosted the IOM technical interchange/workshop in mid-June, which was attended by representatives of all STARS prime contractors and which addressed issues regarding the future applicability of IOM to the STARS Program. Plans are also being developed to support STARS process modeling activities and Navy next generation computing resources (NGCR) environment activities.

Software Architectures Engineering

The Software Architectures Engineering (SAE) Project provides to DoD program offices improvements to the practice of software engineering by assisting in the development and insertion of new architectural and practice models where old models have proved inadequate. The project accomplishes this by assisting in the development of a new set of engineering optimizations (goals) in the application area and setting the requirements for models tunable to the new optimizations. The new models are packaged so that they can be adopted by practitioners in the area by extending the architectures to address possibilities precluded by the current model set. Project members are refining and maturing the new model sets by transitioning them to others and providing additional sources of reflection on their use.

Project members worked on a plan to support Granite Sentry in the future. This activity was put on hold because of reorganization within the Granite Sentry Program. Project members attended meetings at Peterson AFB to provide input to the MITRE assessment and data integrity tiger teams evaluating Granite Sentry.

Project members are completing a final lessons-learned report for the STARS Advanced Millimeter-Wave Seeker (AMMWS) Shadow Project on the Millimeter-Wave Seeker. The report will be ready later in 1990.

The SAE Project is working with Lieutenant Colonel Erik Mettala, manager of the DARPA Domain-Specific Software Architectures (DSSA) Program, to organize and hold a workshop in July to determine the goals and objectives of the DSSA Program. Workshop acceptance letters were sent, and final site preparations are being made. ▶

Acceptance was based on response to a white paper written by the SAE project leader. Project members are writing a direct support agreement for long-term SAE participation in the DSSA Program as research coordinator.

A direct support agreement between the Air Force Electronic Combat Office (AFECO) and the SAE Project was established for work on the Electronic Combat Digital Evaluation System (ECDES). Work in this quarter focused on writing a document that sets the context for the engineering of simulation systems using structural models to coordinate the work of the simulator and computer engineers and presents the system software requirements in terms of the new models.

SAE project information, lessons learned from the C3I domain, and applicability of SAE technology to the Command and Control Evaluation System (CCES) were presented to Computer Resource Management Technology (CRMT) representatives. Project members are evaluating this effort to determine its applicability to the overall SAE strategy and to the C3I domain specifically. The project is also evaluating the need for direct funding to support the effort and strategy.

To support transition of SAE technology and gather information about others doing similar work, project members prepared proposals for TRI-Ada '90 and made presentations to American Management Systems Inc. (AMS), Space Defense Initiative Office/ National Testbed (SDIO), and STARS prime contractors.

Binding of Ada and SQL

The Binding of Ada and SQL Project, initiated at the request of the Ada Joint Program Office (AJPO), has investigated the problem of binding the Ada programming language with the Structured Query Language (SQL) database language. The solution to this problem was the specification of the SQL Ada Module Extensions (SAME), an interface that permits an application program written in Ada to access and manipulate data controlled by a database management system (DBMS) using SQL.

The SAME-Design Committee (SAME-DC) held its June meeting in conjunction with the SQL Rapporteur Group (SRG) of the International Standards Organization Working Group on Ada, ISO/JTC1/SC22/WG9. The SRG announced to the full working group that a complete draft of the *SAME Description Language Reference Manual* (SEI-89-SR-24) will be mailed to each member by October 1, 1990. This should allow the working group to vote on the SAME Description Language (SAMeDL) as a draft proposed standard at its December meeting.

There are now three commercial implementations of the SAMeDL under development. An implementors' workshop is planned for July.

Study and Analysis for Ada 9X

The Ada Joint Program Office (AJPO) has decided that a revision to the Ada language standard is required to maintain it as a standard (ANSI/MIL-STD-1815A). This revision process is commonly referred to as Ada 9X. The purpose of this project is to identify and evaluate potential areas for revising the Ada standard based on the experiences of software developers and compiler implementors. This project is providing an organizational framework to help guide revision activities. ▶

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A draft study report on mathematical processing requirements was received for editing, and revision of the reuse report is nearing completion. The planned report on distributed systems requirements was withdrawn because an active group outside the SEI is proceeding well on identifying those issues.

In June, the Ada 9X program manager asked the SEI to accept a new task to complete the preparation of the Ada 9X requirements work. This request was accepted, and an additional full-time staff member was added to the project to work on this task. A meeting with a small group of the Ada 9X Distinguished Reviewers was held in June to decide on the best approach for completing the requirements definition effort.

Technology Transition

The Technology Transition Program is the focal point for SEI transition efforts. The program works with other SEI programs to match problems and solutions in the DoD software community.

Technology Applications

The Technology Applications Function provides a link between DoD mission-critical application domains and ongoing SEI activities in technology evaluation, development, and transition. The goal of these activities is to assist the efforts of organizations to adopt and institutionalize new technology through matching the technology to an appropriate context, fostering a climate of acceptance for the technology, and tailoring the technology for pilot installations. Transition sites are principally chosen for their ability to influence the further adoption of the technology throughout a larger community.

Members of Technology Applications and the SEI Process Program began to collaborate on transition activities with the Computer Resource Management Technology (CRMT) program of the U.S. Air Force. The CRMT program is the engineering program that the Air Force uses to transition advances in computer resources management, including software technologies, into Air Force practice. Efforts are underway to transition several SEI concepts and products using the CRMT program, including Serpent, the architectural models and processes of the Software Architectures Engineering (SAE) Project, the process maturity model, and the Software Capability Evaluation (SCE) method.

Technology Applications is currently engaged in improvement projects with seven DoD organizations. These projects provide an integrated approach to making improvements and will eventually become a continuous improvement effort within the client organization. For example, Technology Applications is assisting the Air Force Standard Systems Center (SSC) in a comprehensive effort to improve their technical and organizational ability to perform their mission. That mission is to analyze, acquire, design, develop, integrate, test, implement, and maintain standard communication computer systems to support Air Force operations. The improvement project will advocate technological and organizational change and will affect methods, tools, procedures, and policy.

The SSC improvement project was initiated in the SSC Human Resources area and a study of SSC education and training capabilities was completed during this quarter. This study will lead to a professional development plan for SSC staff. The SEI has become familiar with the SSC organizational and technical issues while conducting change management training and development activities with SSC executives. Initial components of a transition infrastructure–a Software Management Council, several technical working groups, and a technology transition group–are now functioning at SSC. In addition, a comprehensive strategy for the entire improvement project was developed in this quarter.

Affiliate Relations

The Affiliate Relations Function establishes and maintains SEI relationships with industry and government organizations. Affiliate Relations also negotiates and places, with the cooperation of the SEI Joint Program Office, government and industry resident affiliates at the SEI. The SEI Education Program manages academic affiliates and visiting scientists from academia.

Eight new industry affiliates signed information exchange agreements during this quarter: Century Technologies, Inc.; Comptek Research, Inc.; IBM, Application Solutions Division; Intel Corporation; Loral Data Systems; Proprietary Software Systems, Inc; Sunstrand Corporation; and Textron Defense Systems.

Two new resident affiliates, one from Gunter Air Force Base Standard Systems Center and one from the National Security Agency, joined the SEI this quarter. Five resident affiliates concluded their work at the SEI during this quarter. As of June 30, 1990, seventeen resident affiliates were working at the SEI: five from industry, two from academia, and ten from the services and government agencies.

Affiliate Relations conducted SEI Visitors Day on May 17, 1990. This event is held quarterly to accommodate the increasing requests for visits to the SEI. Twenty representatives from twelve companies and two government organizations attended. The next Visitors Day is scheduled for August 23, 1990. Visitors must register for Visitors Day; walk-ins are not accepted.

Preparations for the 1990 Affiliates Symposium are underway. The symposium will be held September 11-13, 1990, in Pittsburgh. More than 70 hours of material for tutorials, briefings, and seminars are planned for 32 sessions scheduled during the symposium. The preliminary program and registration information was mailed to all affiliates.

Empirical Methods

The Empirical Methods Function supports transition management of SEI technology projects by providing market research methods and materials, conducting surveys, and evaluating events or validating products of SEI projects.

During this quarter, Empirical Methods staff published a technical report, *National Software Capacity: Near-Term Study* (CMU/SEI-90-TR-12). This study provides an initial assessment of U.S. industrial capacity to produce MCCR (mission-critical computer resources) software. The report describes labor, organizational, and technological issues affecting software production capacity and concludes with some preliminary recommendations for DoD and industry initiatives. For those who want a brief summary of the contents of the report, Empirical Methods staff also published *National Software Capacity: Near-Term Study Executive Summary* (CMU/SEI-90-SR-12).

Empirical Methods staff completed another report this quarter, *Understanding the Adoption of Ada: Results of an Industry Survey* (CMU/SEI-90-SR-10). This report summarizes the results of a survey concerning the economics of Ada adoption and completes SEI efforts to understand and document MCCR industry decisions to adopt or not adopt Ada for use in specific application domains.

National Software Capacity: Near-Term Study
(CMU/SEI-90-TR-12)

Understanding the Adoption of Ada: Results of an Industry Survey
(CMU/SEI-90-SR-10)

National Software Capacity: Near-Term Study Executive Summary
(CMU/SEI-90-SR-12)

For information on how to order reports, see page 27.

CERT Coordination Center

The Computer Emergency Response Team Coordination Center (CERT/CC) supplements existing mechanisms by which informally organized experts deal with and prevent computer emergencies. The CERT/CC at the SEI supports two different communities: Internet users and developers of technology that is available on the network, such as UNIX and networking software. The CERT/CC provides a dependable 24-hour point of contact for security issues and allows rapid communication during emergencies. It also raises constituents' awareness of security issues and assists individual organizations in improving the security of their systems. Finally, the CERT/CC maintains a highly secure repository of information for team members and cultivates close ties with researchers in the area of trusted systems to improve the security of existing systems.

Since its inception in 1988, the CERT/CC has responded to a continuous stream of reported security incidents. These include reports of intrusions, worms, and viruses as well as reports of vulnerabilities and suggested fixes for problems. In handling these problems, the CERT/CC issues advisories to the Internet community to warn them of problems and inform them of preventive techniques. In cases where vulnerabilities exist, the CERT/CC works with software vendors and the technical community in analyzing and resolving the problems.

During the second quarter of 1990, the CERT/CC continued working with the Internet Engineering Task Force (IETF) to produce recommendations for Internet security policy. The Security Policy Working Group held two working meetings, agreed to a policy framework, and initiated work on detailing key security issues. Special emphasis was placed on the unique characteristics of Internet operations where portions of the network are owned and operated by independent, cooperating organizations. Policy development and enforcement will require extensive consensus building and international cooperation.

During initial meetings of the Site Security Policy Handbook Working Group, participants outlined key issues and agreed on the contents of the initial release of the handbook. CERT members organized this second IETF working group whose aim is to produce a security handbook for use by Internet-connected site and system administrators. This handbook will provide guidance on policy, administrative, and technical issues to support efforts at improving the security of their systems.

To raise awareness of security issues and to support organizations' efforts at improving the security of their operational systems, CERT/CC staff members hosted working meetings and participated in professional conferences. The focus of these activities was to share lessons learned and to help other organizations to improve their incident handling capabilities.

The CERT/CC produced a draft charter and conducted, along with the National Institute of Standards and Technology, a membership meeting of the CERT system, a federation ▶

of organizations working together to improve the security of their systems. CERT system charter members, eleven federally funded groups, reached concensus on the charter and expect formal approval and announcement of the system in July 1990. In addition to the charter members, four private organizations have expressed interest in participating in the CERT system. Additionally, the Australian Computer Society has announced its intention to create an Australian Computer Emergency Response Team using the model developed by the CERT/CC at the SEI.

CERT project members conducted the Second Invitational Workshop on Computer Security Incident Response on June 20-21 in Pleasanton, California. This workshop focused on new ideas and models in the area of incident handling as well as lessons learned. There were more than 100 attendees and 40 speakers from the federal government, academic community, and private industry. The workshop highlighted advancements in the following areas: improved incident response capabilities, development of models to characterize and analyze security threats, development of tools and techniques for improving the security of network communications and system operation, and the development of publicly available information resources.

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